CLAIMS:

1. A catalyst regenerator, comprising:

(a) a regeneration zone into which a regeneration medium and an at least partially coked catalyst from a reactor can be fed, wherein the regeneration zone has a first lower end, a first upper end and a first major length therebetween;

(b) a separation zone provided to separate entrained catalyst from gaseous components and return the entrained catalyst to the regeneration zone, wherein the separation zone has a second lower end, a second upper end and a second major length therebetween, wherein the ratio of the second major length to the first major length is greater than 1.0, the second lower end is in fluid communication with the first upper end, and the separation zone includes a swaged region adjacent the second lower end of the separation zone; and

(c) a catalyst return into which regenerated catalyst can be fed from the regeneration zone and from which the regenerated catalyst can be directed to the reactor.

2. The catalyst regenerator of claim 1, wherein the ratio of the second major length to the first major length is greater than 1.25.

3. The catalyst regenerator of claim 2, wherein the ratio is greater than 2.0.

4. The catalyst regenerator of claim 3, wherein the ratio is greater than 4.0.

5. The catalyst regenerator of claim 1, wherein the regeneration zone has a first average diameter and the separation zone has a second average diameter, and wherein the ratio of the second average diameter to the first average diameter is at least 1.1.

6. The catalyst regenerator of claim 5, wherein the ratio of the second average diameter to the first average diameter is at least 1.4.

7. The catalyst regenerator of claim 6, wherein the ratio of the second average diameter to the first average diameter is at least 2.0.

8. The catalyst regenerator of claim 1, wherein the regeneration zone has a first average cross-sectional area and the separation zone has a second average cross-sectional area, and wherein the ratio of the second average cross-sectional area to the first average cross-sectional area is at least 1.2.

9. The catalyst regenerator of claim 8, wherein the ratio of the second average cross-sectional area to the first average cross-sectional area is at least 2.0.

10. The catalyst regenerator of claim 9, wherein the ratio of the second average cross-sectional area to the first average cross-sectional area is at least 3.0.

11. The catalyst regenerator of claim 10, wherein the ratio of the second average cross-sectional area to the first average cross-sectional area is at least 4.0.

12. The catalyst regenerator of claim 1, wherein the gaseous components include combustion products of a regeneration process.

13. The catalyst regenerator of claim 12, wherein the separation zone includes an exhaust outlet through which the gaseous components can exit the catalyst regenerator.

14. The catalyst regenerator of claim 1, wherein the regeneration medium comprises molecular oxygen.

15. The catalyst regenerator of claim 1, wherein the separation zone contains a cyclone separation device.

16. The catalyst regenerator of claim 1, wherein the reactor comprises a methanol-to-olefin reactor.

17. The catalyst regenerator of claim 1, wherein the at least partially coked catalyst has a d_{50} particle size from about 20 to about 200 microns.

18. The catalyst regenerator of claim 1, wherein the at least partially coked catalyst contains molecular sieve particles selected from the group consisting of SAPO-5, SAPO-8, SAPO-11, SAPO-16, SAPO-17, SAPO-18, SAPO-20, SAPO-31, SAPO-34, SAPO-35, SAPO-36, SAPO-37, SAPO-40, SAPO-41, SAPO-42, SAPO-44, SAPO-47, SAPO-56, the metal containing forms thereof, and mixtures thereof.

19. The catalyst regenerator of claim 1, further comprising:
one or more obstructing members positioned within the separation zone for at least partially obstructing the upward flow of entrained catalyst.

20. The catalyst regenerator of claim 1, further comprising:
one or more obstructing members positioned within the regeneration zone for at least partially obstructing the upward flow of entrained catalyst.

21. A catalyst regenerator, comprising:

(a) a regeneration zone having a first major length;

(b) a separation zone having a second major length, wherein at least a portion of the separation zone is oriented above the regeneration zone; and

(c) an intermediate zone connecting the regeneration zone to the separation zone,

wherein the ratio of the second major length to the first major length is greater than 1.0.

22. The catalyst regenerator of claim 21, wherein the ratio of the second major length to the first major length is greater than 1.25.

23. The catalyst regenerator of claim 22, wherein the ratio is greater than 2.0.

24. The catalyst regenerator of claim 23, wherein the ratio is greater than 4.0.

25. The catalyst regenerator of claim 21, wherein the regeneration zone has a first average diameter and the separation zone has a second average diameter, and wherein the ratio of the second average diameter to the first average diameter is at least 1.1.

26. The catalyst regenerator of claim 25, wherein the ratio of the second average diameter to the first average diameter is at least 1.4.

27. The catalyst regenerator of claim 26, wherein the ratio of the second average diameter to the first average diameter is at least 2.0.

28. The catalyst regenerator of claim 21, wherein the regeneration zone has a first average cross-sectional area and the separation zone has a second average cross-sectional area, and wherein the ratio of the second average cross-sectional area to the first average cross-sectional area is at least 1.2.

29. The catalyst regenerator of claim 28, wherein the ratio of the second average cross-sectional area to the first average cross-sectional area is at least 2.0.

30. The catalyst regenerator of claim 29, wherein the ratio of the second average cross-sectional area to the first average cross-sectional area is at least 3.0.

31. The catalyst regenerator of claim 30, wherein the ratio of the second average cross-sectional area to the first average cross-sectional area is at least 4.0.

32. The catalyst regenerator of claim 21, wherein the separation zone separates gaseous components from entrained catalyst and returns the entrained catalyst to the regeneration zone.

33. The catalyst regenerator of claim 32, wherein the separation zone includes an exhaust outlet through which the gaseous components are releasable from the catalyst regenerator.

34. The catalyst regenerator of claim 21, wherein the regeneration zone receives a regeneration medium and an at least partially coked catalyst from a methanol-to-olefin reactor.

35. The catalyst regenerator of claim 34, wherein the methanol-to-olefin reactor receives regenerated catalyst from the catalyst regenerator.

36. The catalyst regenerator of claim 34, wherein the regeneration medium comprises molecular oxygen.

37. The catalyst regenerator of claim 34, wherein the at least partially coked catalyst has a d_{50} particle size from about 20 to about 200 microns.

38. The catalyst regenerator of claim 34, wherein the at least partially coked catalyst contains molecular sieve particles selected from the group

consisting of SAPO-5, SAPO-8, SAPO-11, SAPO-16, SAPO-17, SAPO-18, SAPO-20, SAPO-31, SAPO-34, SAPO-35, SAPO-36, SAPO-37, SAPO-40, SAPO-41, SAPO-42, SAPO-44, SAPO-47, SAPO-56, the metal containing forms thereof, and mixtures thereof.

39. The catalyst regenerator of claim 21, wherein the separation zone contains a cyclone separation device.

40. The catalyst regenerator of claim 21, further comprising:
one or more obstructing members positioned within the separation zone for at least partially obstructing the upward flow of entrained catalyst.

41. The catalyst regenerator of claim 21, further comprising:
one or more obstructing members positioned within the regeneration zone for at least partially obstructing the upward flow of entrained catalyst.

42. A catalyst regenerator, comprising:
(a) a regeneration zone having a first average cross-sectional area;
(b) a separation zone having a second average cross-sectional area; wherein at least a portion of the separation zone is oriented above the regeneration zone; and
(c) an intermediate zone connecting the regeneration zone to the separation zone, wherein the ratio of the second average cross-sectional area to the first average cross-sectional area is at least 1.2.

43. The catalyst regenerator of claim 42, wherein the ratio is at least 2.0.

44. The catalyst regenerator of claim 43, wherein the ratio is at least 3.0.

45. The catalyst regenerator of claim 44, wherein the ratio is at least 4.0.

46. The catalyst regenerator of claim 45, wherein the ratio is at least 5.3.

47. The catalyst regenerator of claim 42, wherein the regeneration zone has a first major length and the separation zone has a second major length, and wherein the ratio of the second major length to the first major length is greater than 1.0.

48. The catalyst regenerator of claim 47, wherein the ratio of the second major length to the first major length is greater than 1.25.

49. The catalyst regenerator of claim 48, wherein the ratio of the second major length to the first major length is greater than 2.0.

50. The catalyst regenerator of claim 49, wherein the ratio of the second major length to the first major length is greater than 4.0.

51. The catalyst regenerator of claim 42, wherein the separation zone separates gaseous components from entrained catalyst and returns the entrained catalyst to the regeneration zone.

52. The catalyst regenerator of claim 51, wherein the separation zone includes an exhaust outlet through which the gaseous components are releasable from the catalyst regenerator.

53. The catalyst regenerator of claim 42, wherein the regeneration zone receives a regeneration medium and an at least partially coked catalyst from a methanol-to-olefin reactor.

54. The catalyst regenerator of claim 53, wherein the methanol-to-olefin reactor receives regenerated catalyst from the catalyst regenerator.

55. The catalyst regenerator of claim 53, wherein the regeneration medium comprises molecular oxygen.

56. The catalyst regenerator of claim 53, wherein the at least partially coked catalyst has a d_{50} particle size from about 20 to about 200 microns.

57. The catalyst regenerator of claim 53, wherein the at least partially coked catalyst contains molecular sieve particles selected from the group consisting of SAPO-5, SAPO-8, SAPO-11, SAPO-16, SAPO-17, SAPO-18, SAPO-20, SAPO-31, SAPO-34, SAPO-35, SAPO-36, SAPO-37, SAPO-40, SAPO-41, SAPO-42, SAPO-44, SAPO-47, SAPO-56, the metal containing forms thereof, and mixtures thereof.

58. The catalyst regenerator of claim 42, wherein the separation zone contains a cyclone separation device.

59. The catalyst regenerator of claim 42, further comprising:
one or more obstructing members positioned within the separation zone for at least partially obstructing the upward flow of entrained catalyst.

60. The catalyst regenerator of claim 42, further comprising:
one or more obstructing members positioned within the regeneration zone for at least partially obstructing the upward flow of entrained catalyst.

61. A process for regenerating catalyst, wherein the process comprises the steps of:

(a) receiving a coked catalyst in a regeneration zone from a reactor;

(b) contacting the coked catalyst with a regeneration medium in the regeneration zone at a first superficial velocity and under conditions effective to convert at least a portion of the coked catalyst to regenerated catalyst and forming gaseous products;

(c) directing the gaseous products and entrained catalyst from the regeneration zone to a separation zone, wherein the entrained catalyst flows in the separation zone at a second superficial velocity;

(d) separating a majority of the gaseous products in the separation zone from a majority of the entrained catalyst in the separation zone;

(e) returning the majority of the entrained catalyst to the regeneration zone; and

(f) directing the regenerated catalyst from the regeneration zone to the reactor, wherein the ratio of the first superficial velocity to the second superficial velocity is at least 1.2.

62. The process of claim 61, wherein the ratio is at least 2.0.

63. The process of claim 62, wherein the ratio is at least 3.0.

64. The process of claim 63, wherein the ratio is at least 4.0.

65. The process of claim 64, wherein the ratio is at least 5.3.

66. The process of claim 65, wherein the ratio is at least 6.8.

67. The process of claim 66, wherein the ratio is at least 8.5.

68. The process of claim 61, wherein the second superficial velocity is less than 1.0 meters per second.

69. The process of claim 68, wherein the second superficial velocity is less than 0.5 meters per second.

70. The process of claim 69, wherein the second superficial velocity is less than 0.25 meters per second.

71. The process of claim 70, wherein the second superficial velocity is less than 0.1 meters per second.

72. The process of claim 61, wherein the coked catalyst forms a dense bed in the regeneration zone, wherein the dense bed comprises from about 2 to about 45 volume percent of the regeneration zone, based on the total volume of the regeneration zone.

73. The process of claim 61, wherein the contacting of the coked catalyst with the regeneration medium in the regeneration zone occurs at a temperature of at least about 538°C.

74. The process of claim 73, wherein the temperature is at least 649°C

75. The process of claim 74, wherein the temperature is at least 704°C.

76. The process of claim 61, wherein the reactor is a methanol-to-olefin reactor.

77. The process of claim 76, wherein the process further comprises the step of:
(g) contacting methanol in the reactor with a molecular sieve catalyst under conditions effective to convert at least a portion of the methanol to light olefins and to form the coked catalyst.

78. The process of claim 77, wherein the molecular sieve catalyst is a partially-coked molecular sieve catalyst.

79. The process of claim 77, wherein the molecular sieve catalyst is selected from the group consisting of SAPO-5, SAPO-8, SAPO-11, SAPO-16, SAPO-17, SAPO-18, SAPO-20, SAPO-31, SAPO-34, SAPO-35, SAPO-36, SAPO-37, SAPO-40, SAPO-41, SAPO-42, SAPO-44, SAPO-47, SAPO-56, the metal containing forms thereof, and mixtures thereof.

80. The process of claim 61, wherein the coked catalyst has a d_{50} particle size from about 20 to about 200 microns.

81. The process of claim 61, wherein step (d) occurs in a cyclone separator situated within the separation zone.

82. A process for regenerating catalyst, wherein the process comprises the steps of:

(a) receiving a coked catalyst in a regeneration zone from a reactor;

(b) contacting the coked catalyst with a regeneration medium in the regeneration zone at a first superficial velocity and under conditions effective to convert at least a portion of the coked catalyst to regenerated catalyst and forming gaseous products;

(c) directing the gaseous products and entrained catalyst from the regeneration zone to a separation zone, wherein the entrained catalyst flows in the separation zone at a second superficial velocity, the second superficial velocity being less than the first superficial velocity;

(d) separating a majority of the gaseous products in the separation zone from a majority of the entrained catalyst in the separation zone;

(e) returning the majority of the entrained catalyst to the regeneration zone;

(f) releasing a flue gas stream comprising the majority of the gaseous products from the separation zone, wherein the flue gas stream contains less than about 0.5 weight percent entrained catalyst, based on the total weight of the flue gas stream; and

(g) directing the regenerated catalyst from the regeneration zone to the reactor.

83. The process of claim 82, wherein the flue gas stream contains less than 0.05 weight percent entrained catalyst, based on the total weight of the flue gas stream.

84. The process of claim 83, wherein the flue gas stream contains less than 0.005 weight percent entrained catalyst, based on the total weight of the flue gas stream.

85. The process of claim 82, wherein the ratio of the first superficial velocity to the second superficial velocity is at least 1.2.

86. The process of claim 85, wherein the ratio of the first superficial velocity to the second superficial velocity is at least 2.0.

87. The process of claim 86, wherein the ratio of the first superficial velocity to the second superficial velocity is at least 3.0.

88. The process of claim 87, wherein the ratio of the first superficial velocity to the second superficial velocity is at least 4.0.

89. The process of claim 88, wherein the ratio of the first superficial velocity to the second superficial velocity is at least 5.3.

90. The process of claim 89, wherein the ratio of the first superficial velocity to the second superficial velocity is at least 6.8.

91. The process of claim 90, wherein the ratio of the first superficial velocity to the second superficial velocity is at least 8.5.

92. The process of claim 82, wherein the second superficial velocity is less than about 1.0 meters per second.

93. The process of claim 92, wherein the second superficial velocity is less than 0.5 meters per second.

94. The process of claim 93, wherein the second superficial velocity is less than 0.25 meters per second.

95. The process of claim 94, wherein the second superficial velocity is less than 0.1 meters per second.

96. The process of claim 82, wherein the coked catalyst forms a dense bed in the regeneration zone, wherein the dense bed comprises from about 2 to about 45 volume percent of the regeneration zone, based on the total volume of the regeneration zone.

97. The process of claim 82, wherein the contacting of the coked catalyst with the regeneration medium in the regeneration zone occurs at a temperature of at least about 538°C.

98. The process of claim 97, wherein the temperature is at least 649°C.

99. The process of claim 98, wherein the temperature is at least 704°C.

100. The process of claim 82, wherein the reactor is a methanol-to-olefin reactor.

101. The process of claim 100, wherein the process further comprises the step of:

(h) contacting methanol in the reactor with a molecular sieve catalyst under conditions effective to convert at least a portion of the methanol to light olefins and to form the coked catalyst.

102. The process of claim 101, wherein the molecular sieve catalyst is a partially-coked molecular sieve catalyst.

103. The process of claim 101, wherein the molecular sieve catalyst is selected from the group consisting of SAPO-5, SAPO-8, SAPO-11, SAPO-16, SAPO-17, SAPO-18, SAPO-20, SAPO-31, SAPO-34, SAPO-35, SAPO-36, SAPO-37, SAPO-40, SAPO-41, SAPO-42, SAPO-44, SAPO-47, SAPO-56, the metal containing forms thereof, and mixtures thereof.

104. The process of claim 82, wherein the coked catalyst has a d_{50} particle size from about 20 to about 200 microns.

105. The process of claim 82, wherein step (d) occurs in a cyclone separator situated within the separation zone.